Attachment A

City of Milwaukee
Health Department Bureau of Consumer Protection and Environmental Health

Gregory M Carmichael Director
Paul A Biedrzycki Manager
Environmental Health Technical Division
Gregory J Jach Manager
Vector and Nuisance Control Division
Carey D Meier Manager
Enforcement and Training Division
Loyce C Robinson Manager
Consumer Protection Division

Room 105, Municipal Building, 841 North Broadway, Milwaukee, Wisconsin 53202-3653

October 20, 1993

REF 8

TO: Steve Hiniker
Environmental Policy Coordinator
Department of Administration

THROUGH: Greg Carmichael, Ph.D., MBA
Bureau Director

FROM; Rudy Salcedo, Ph.D., REP, CHMM, CHME RS
Environmental Scientist, Health Dept.

Lisa R. Burns, Graduate Intern
DCD

SUBJECT: Phase I Environmental Investigation: Former Milwaukee Solvay Coke & Gas Co. Site (311 E. Greenfield Avenue)

Per your October 11, 1993 request, this is a modified Phase I environmental investigation of the former Milwaukee Solvay Coke and Gas Co. site, located at 311 East Greenfield Avenue ("project site"). We understand that the Port of Milwaukee is interested in acquiring this property.

The project site is bordered by E. Greenfield Ave. to the north, the Kinnickinnic River Basin to the south and east, and the north-south Soo Line Railroad tracks to the west. (Map 1) This heavily industrialized site is in the Menomonee River Industrial Valley.

This Phase I environmental investigation involved the following activities designed to determine potential environmental concerns (i.e., "red flags") associated with this property and immediate surrounding areas:

1. Site visits and exterior inspection of the property and surrounding areas on October 11 and 20, 1993. (Note: A large portion of the property is not readily accessible without being intrusive. Therefore, many interior portions of the property could not be adequately observed for this report.)

2. Investigation into the present and previous land uses of the

site and immediate surrounding areas. (Note: Available historical land use information is adequate to form a basis for a considered opinion regarding the environmental condition of this property.)

3. Interviews with city staff familiar with the history of the property.

In brief, there are reasons to believe that this property -- formerly used as a coal storage facility, a coking plant, a coal-gas production plant, and a steel company plant -- is contaminated. This conclusion is based on the present and previous uses of this property, their products and by-products, the types of pollutants which the Wisconsin DNR has required to be analyzed from a former coal and foundry products storage facility (1600 W. Canal St.), and the high levels of soil and groundwater contamination found in another former coal gasification facility in Milwaukee (Third Ward Coal Gasification Plant).

It would be prudent to conduct a Phase II environmental investigation of this property before acquisition. We recommend that this Phase II investigation be conducted under the aegis of the City of Milwaukee's long-term Phase II contract with Simon Hydro-Search, Inc. We believe that this contract could be signed shortly.

There are many potential soil and groundwater pollutants associated with this property. These pollutants include, but may not be limited to, the following:

a. Gasoline Range Organics (GRO)
b. Diesel Range Organics (DRO)
c. Total Recoverable Petroleum Hydrocarbons (TRPH)
d. Polychlorinated Biphenyls (PCBs)
e. Total and Reactive Cyanides
f. Resource Conservation and Recovery Act (RCRA) metals (Total and Leachable portions)
g. Polynuclear Aromatic Hydrocarbons (PAH)
h. Semi-volatile Organics
i. Non-Volatile Organics
j. Acids
h. Priority Pollutants Volatile Organic Compounds (PPVOC)
i. Sulfates
j. Phenol

We would be happy to help design a Phase II environmental investigation of this property. The immense size of this property

(almost 46 acres), and its present uses (coal storage, vehicle storage, railroad tracks ROW, concrete recycling, and the remaining tanks and structures associated with the former coking and coal-gas facility), will require a more intensive site inspection than that which we were able to conduct. We would also require a "Right of Entry" issued by the present owner and/or its present tenant. (Note: The present tenant might not be willing to allow entry for environmental assessment purposes because it has signed a lease-purchase agreement with the owner of this property.) (Attachment A).

In any case, this Phase II environmental investigation should be preceded by a systematic search for underground storage tanks and underground utility fixtures in the premises. Because of the many metallic structures and objects on the site, a simple magnetometer search might not suffice. A Ground Penetrating Radar (GPR) or something equivalent, that would not be affected by the metals on the site, may have to be used. This could drive the Phase II costs higher. In addition, a systematic search for asbestos containing building materials should be conducted in the premises. This is especially important if the buildings will be demolished or rehabilitated.

Assuming a total of 30 soil borings each to 15 ft. deep (the shallow groundwater in the area might be higher), and 10 co-located groundwater wells, this Phase II investigation could cost at least $55,000, considering the number and types pollutants that will have to be analyzed.

FINDINGS:

1. The City Treasurer's records indicate that 311 E. Greenfield Ave. has a lot size of almost 46 acres (2,002,018 sq.ft.).

2. For purposes of this review, this site includes: (a) 401 E. Greenfield Ave.,the approximately 15-acre former C & O (Chesapeake and Ohio) parcel immediately south of E. Greenfield Ave., between the Chicago and NorthWestern Railway Tracks on the west, and the west bank of the Kinnickinnic River Basin to the east; (2) 311 E. Greenfield Ave., between the Soo Line RR tracks (west) and the CN&NW RR tracks (east), also about 15 acres, where the main manufacturing activities of the former Milwaukee Solvay Coke and Gas Co. took place; and (c) the southern parcel, approximately 16 acres, which reportedly was once the site of a Thomas Furnace

Co./Illinois Steel Co. Plant. (Source: HNT&B, RERC and Soros Associates, "Analysis of Potential Demand for Certain Lands in the Inner Harbor Area of the Menomonee River Valley Redevelopment Project; Final Report," May 1978).

3. The project site is generally flat. It is currently leased by the Wisconsin Wrecking Co. a recycler of concrete. Wisconsin Wrecking Co. breaks up chunks of concrete taken from demolished structures and roadways and sells the aggregate for construction and "environmentally clean fill" purposes.

4. The site is laced with railroad tracks and contains the remnants of the Milwaukee Solvay Coke and Gas Co. operations (e.g., residues, at least four buildings, two or three tanks, etc.). It is currently used for the storage of vehicles, coal and crushed concrete. On October 11, 1993, a coal boat was unloading (by conveyor) coal onto two huge piles located at the northeastern portion of the site, close to the KK River Basin.

5. In the early 1900's, the property was also known as 187 E. Greenfield Ave. However, for the sake of simplicity, the project site will be referred to as 311 E. Greenfield Ave. throughout this report.

6. Records with the Department of City Development's Real Estate Section indicate that in 1983, the Wisconsin Wrecking Co. entered into a lease/purchase agreement with Cliffs Mining Co. (fka Pickands Mather & Co.). The lease-purchase agreement will expire in 1995. Mr. Delbert Dettmann of DCD's Real Estate Section indicated that Wisconsin Wrecking Co., -- the current occupant and leasee -- is still interested in buying this property. (Attachment A).

7. The Wright's City of Milwaukee Directories (1935-1992), and the HNT&B/RERC/Soros report (1978) indicate the following present and previous users of the project site. The land uses which present potential environmental concerns (i.e., "red flags") are asterisked (*) because they are thought to have handled, used, stored, generated, treated, or disposed hazardous materials or hazardous wastes.

Present/Previous User	Potential Concern
Wisconsin Wrecking Co. 1984-92	
*Milwaukee Solvay Coke Coal wholesale/dealer 1965-83	See list below

*Milwaukee Coke Co. Plant 1945-60	See list below
*Milwaukee Coke and Gas Co. & Milwaukee Co. Plant 1925-40	See list below
*Thomas Furnace Co./Illinois Steel Co. Plant (undated)	See list below

(Note: The combined list of potential pollutants associated with the asterisked (*) land uses include the following: Gasoline Range Organics (GRO), Diesel Range Organics (DRO), Total Recoverable Petroleum Hydrocarbons (TRPH), Polychlorinated Biphenyls (PCBs), Cyanides, RCRA metals, Polynuclear Aromatic Hydrocarbons (PAHs), Semi-volatile Organics, Non-Volatile Organics, Acids, and Priority Pollutants Volatile Organic Compounds (PPVOC)), sulfates and phenol.

8. The Milwaukee Solvay Coke Co. plant was still in operation in the 1970s, although they were reported at that time to have shut down many of their coke ovens due to excessive dust emissions into the ambient air. At that time, the Wisconsin DNR used to identify the Milwaukee Solvay Coke Co. as the largest industrial source of dust pollution in the Menomonee Valley.

9. Available records from the Milwaukee County Historical Society Museum also indicate that Milwaukee Solvay Coke Company may have been a Division of Wisconsin Gas Co. (WICOR). Other Company name, besides Milwaukee Solvay Coke Co., includes The Milwaukee Coke and Gas Company. It was founded by Armin A. Schlesinger in 1902. It had a peak employment of 601 workers in 1955. The plant reportedly processed up to 800 tons of coal per day, to produce coke for foundries. The plant closed down in 1983; it had 140 employees that year.

Excerpts adapted from Men of Achievement in Milwaukee (John Morantz & Associates, Milwaukee, 1946, p. 218) about the Milwaukee Solvay Coke Co. are presented below:

> The Milwaukee Solvay Coke Co., with its plant at 311 E. Greenfield Ave., and its sales office at 740 N. Milwaukee Street, Milwaukee, WI was incorporated in the State of Wisconsin on December 9, 1902 as the Milwaukee Coke and Gas Company.
>
> Products manufactured by this company include: metallurgical coke, coal gas, coal tar, ammoniacal liquor, benzol, toluol, xylol and pyridine.

> In time of war, these products are essentially important, as steel manufacturers require large quantities of coke. Ammonia and toluol are used in the manufacture of explosives. Peace-time products are the same as those produced during the war. Coke is used by the metallurgical trade and for domestic purposes. Gas is sold to the Milwaukee Gas Light Company, which supplies gas for public use in the vicinity of Milwaukee. Other by-products are sold for industrial use.

10. Excerpts adapted from the 1984 Edition of the Encyclopedia Americana briefly describe the coking process and it's by-products. Many of the by-products are classified as hazardous materials; these are bases of potential environmental concerns regarding this property:

> Coke is the solid residue, consisting chiefly of carbon, that is left behind when bituminous coal or petroleum or other liquid hydrocarbons are distilled in the absence of air. Coke made from coal and used as a fuel is by far the most important type of commercial coke.
>
> Coke made from bituminous coal is a reliable fuel that consists chiefly of fixed carbon with less than 10% ash. It is gray in color, coherent, infusible, cellular and porous. In the production of coke, a process called "carbonization of coal" or "coking", most of the volatile matter is removed by heating the coal in a closed chamber to retard or prevent burning.
>
> In most modern coking operations, a large number of valuable by-products are recovered from the volatile matter distilled from the coal. Among the most important of these by-products are coal gas, coal tar, ammonium sulfate, and benzol.
>
> At the start of the coking operation, doors on each end of the retort are sealed, and the coal is charged through openings in the top. At the top and the ends of the coking chambers are openings for collecting the volatile matter as it evolves during the heating cycle. These openings are fitted to pipes that carry the gases to chemical recovery units where the by-products of coking are obtained.
>
> At the end of the coking cycle, both end doors of the chamber are opened and a "pusher" mechanism shoves the block of incandescent coke into a quenching car. The car then advances to a spray system that rapidly cools the coke to

prevent combustion. The quenching operation is precisely controlled so that the final moisture content of the coke will average 2.5%. After quenching, the coke is crushed and screened for proper sizing for specific applications.

The recovery of coal chemicals is as important as the coking process. The recovery system is extremely complex, but essentially, it involves the condensation or extraction of the desired products from the gases of the coke-oven exhaust stream.

The carbonization of a ton of coal produces an average yield of about 0.7 ton of coke; 11,500 cuft. (345 cubic meters) of gas; 12 gallons (45.6 liters) of tar; 27 pounds (12 kg) of ammonium sulfate; 50 gallons (190 liters) of benzol; 0.9 gallon (3.4 liters) of toloul and naptha; and 0.5 pound (0.2kg) of napthalene.

11. Rascher's 1888 Map of the City of Milwaukee (updated 1892) indicate that the southern portion of the project site was a swamp. This is significant as the sources and quality of the fill material used in raising this area above the water table are not known. The map also shows that the property was a coal yard, owned or operated by the Milwaukee Eggette Coal Co. (For the sake of brevity, the map is not presented here, although tracings were made of the map.)

12. A 1920 Land Use Map of the project site shows many buildings labeled "shops", and other structures such as ammonia tanks, coal bins, and a furnace. (Map 2).

13. A batch of 56 high quality glossy 7.5" x 9.5" photographs of the Milwaukee Coke and Gas Plant taken in the late 1920s and early 1930s is available from DCD's Historic Preservation files. Four pictures (Attachments B to E) are reproduced for this report to show the heavy industrial nature of this property. Note the tanks and the tar separator shown in the pictures.

14. A 1962 Land Use Map of the project site shows the project site laced with railroad tracks, many industrial buildings, coal storage, coke processing furnaces, and many round structures of varying sizes. These round structures may have been storage tanks and smokestacks. (Map 3)

15. A 1969 Sanborn Fire Insurance Map of the project site describes

the Milwaukee Solvay Coke Co. as a "Coke and Artificial Gas Plant." It also shows coke ovens, coal storage areas, and a number of tanks, including condensing tanks, gas tanks and oil tanks. (Map 4)

16. According to the Wisconsin Department of Natural Resources, coal and foundry products storage facilities are associated with a number of potential soil and groundwater pollutants, including the following: total recoverable petroleum hydrocarbons, cyanides, RCRA metals, polynuclear aromatic hydrocarbons (PAH), priority pollutants volatile organic compounds (PPVOC), sulfates, and phenol. (Source: WDNR April 23, 1990 communications, re 1600 W. Canal Street, Milwaukee.)

17. Attached Pollution Engineering article on coal gas plants indicates the types of pollutants that could be anticipated from such facilities. Note that many of the pollutants indicated do not readily biodegrade. This means that the heavy hydrocarbons that are associated with coke and coal-gas production may still be at 311 E. Greenfield Ave. (Attachment F.)

18. In 1992, the Wisconsin Gas Co. commissioned a Phase II environmental investigation of the former Third Ward Coal Gasification Plant in Milwaukee. In general, the concentrations of Volatile Organic Compounds (VOC) and Polynuclear Aromatic Hydrocarbons (PAH) found in the soil and groundwater samples were the highest we have ever seen. The pollutant concentrations were as high as million parts per billion. (Source: "Phase III Environmental Site Investigation Report, Former Third Ward Manufactured Gas Plant Site", (April 1993), prepared for the Wisconsin Gas Company by Remediation Technologies (RETEC), Inc. and Atlantic Environmental Services, Inc.). We note that PAH is a family of heavy hydrocarbons some of which are known or suspected human carcinogens.

19. Not much emphasis was placed on the character of the surrounding areas because of the previous uses of 311 E. Greenfield Ave. and the types of potential pollutants associated with those uses. Of note, however, are the former Northwestern-Hanna Fuel Co. dock (tank farm), located at 316 E. Greenfield Ave., across the street from the former Solvay Coke & Gas plant, and the existing Grede Foundry Heat Treat Plant, immediately west of the project site.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Based on the above findings, there is reason to suspect that the project site is contaminated. Further, the types of soil and groundwater contamination that may be potentially found at the former Milwaukee Solvay Coke and Gas Plant (311 E. Greefield Ave.) may be similar to those found in the former Third Ward Coal Gasification Plant in Milwaukee.

It would be prudent to conduct a Phase II environmental investigation of this property before acquisition. We further recommend that this Phase II investigation be conducted under the aegis of the City of Milwaukee's long-term Phase II contract with Simon Hydro-Search, Inc. We believe that this contract could be signed shortly.

The potential pollutants to analyzed are listed in Finding Item No. 7 of this report. We would be happy to help design a Phase II environmental investigation of this property. The immense size of this property (almost 46 acres), and its present uses (coal storage, vehicle storage, railroad tracks ROW, concrete recycling, and the remaining residues, tanks and buildings associated with the former coking and coal-gas facility), will require a more intensive site inspection than that which we were able to conduct.

We would also require a "Right of Entry" issued by the present owner and/or its present tenant. (Note: The present tenant might not be be willing to grant a Right of Entry because they have signed a lease-purchase agreement with the owners of this property.

In any case, this Phase II environmental investigation should be preceded by a systematic search for underground storage tanks and utility fixtures in the premises. Because of the many metallic structures and objects on the site, a simple magnetometer search might not suffice. A Ground Penetrating Radar (GPR), or something equivalent that would not be affected by the metals on the site, may have to be used. This could drive the costs of the Phase II investigations higher. In addition, a systematic search for asbestos-containing building materials should be conducted in the premises. This is especially important if the buildings will be demolished or rehabilitated.

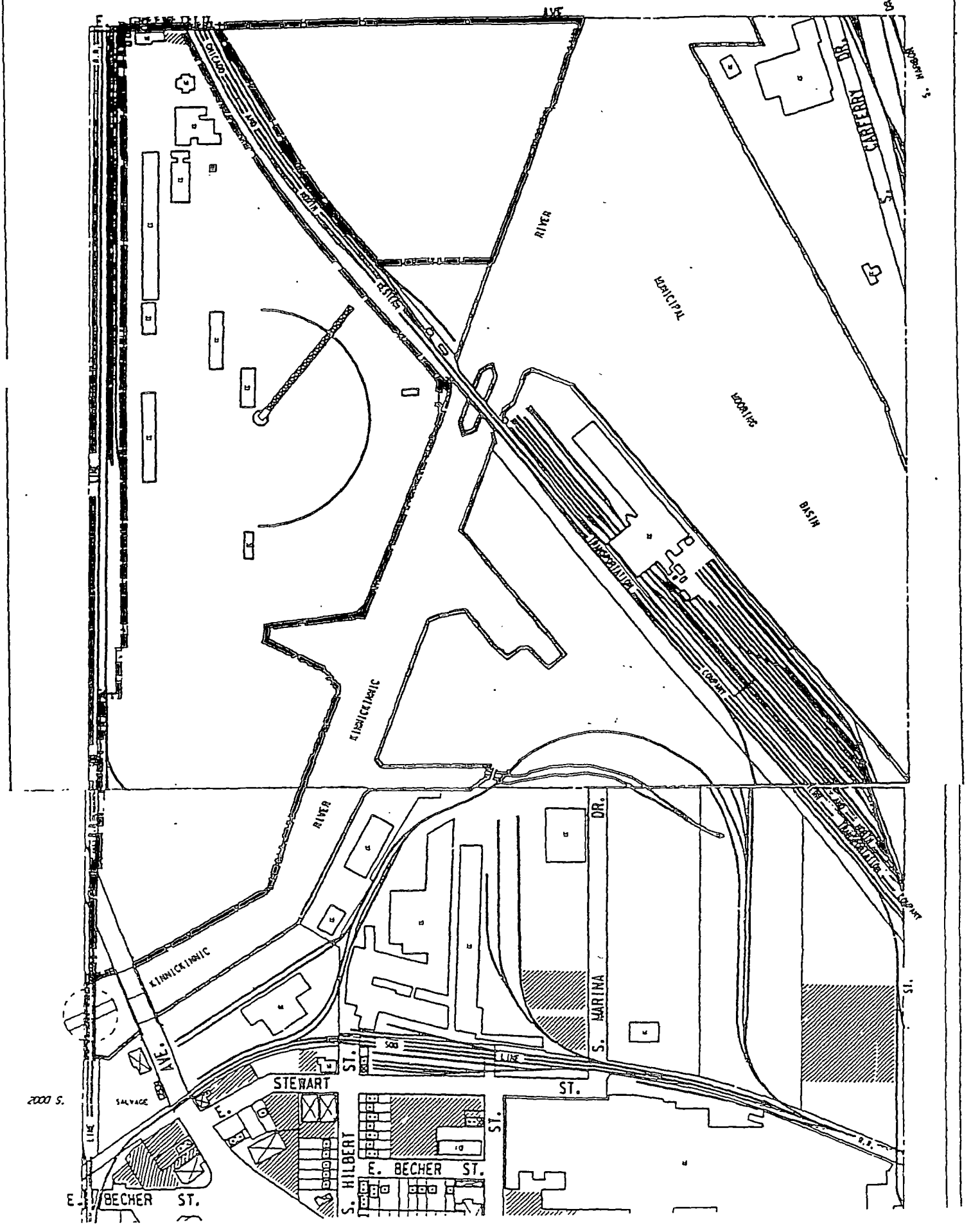
Assuming a total of 30 soil borings each to 15 feet deep (the shallow groundwater in the area might be higher), and 10 co-located groundwater wells, this Phase II investigation could cost at least $55,000, considering all the pollutants that have to be analyzed.

Steve Hiniker, Continued
Milwaukee Solvay Coke Co.

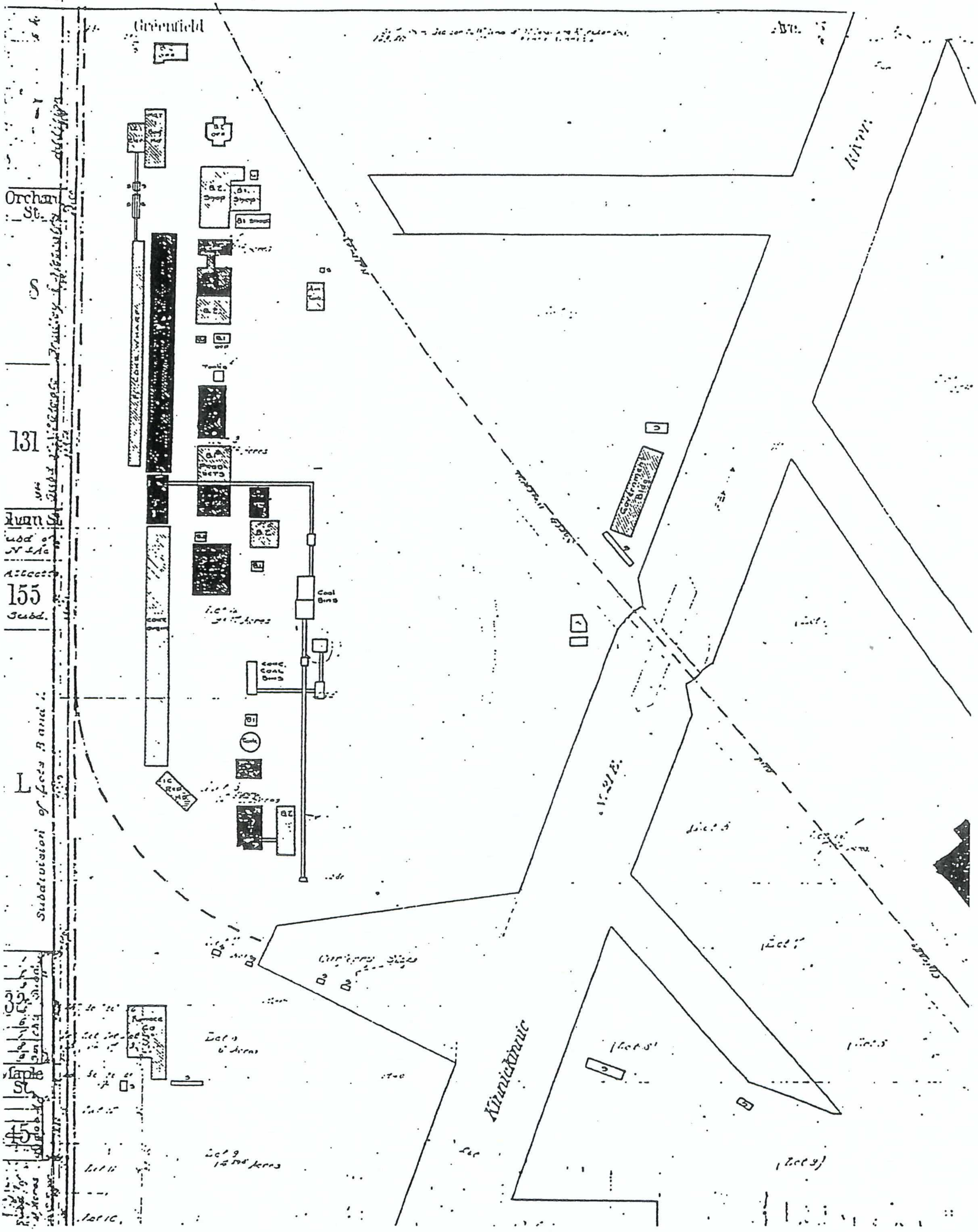
Attachments

cc: D. Boyce, DCD
G. Carmichael, Health
K. Szallai, Port of Milwaukee
T. Miller, DCD
R. Salcedo/L. Burns

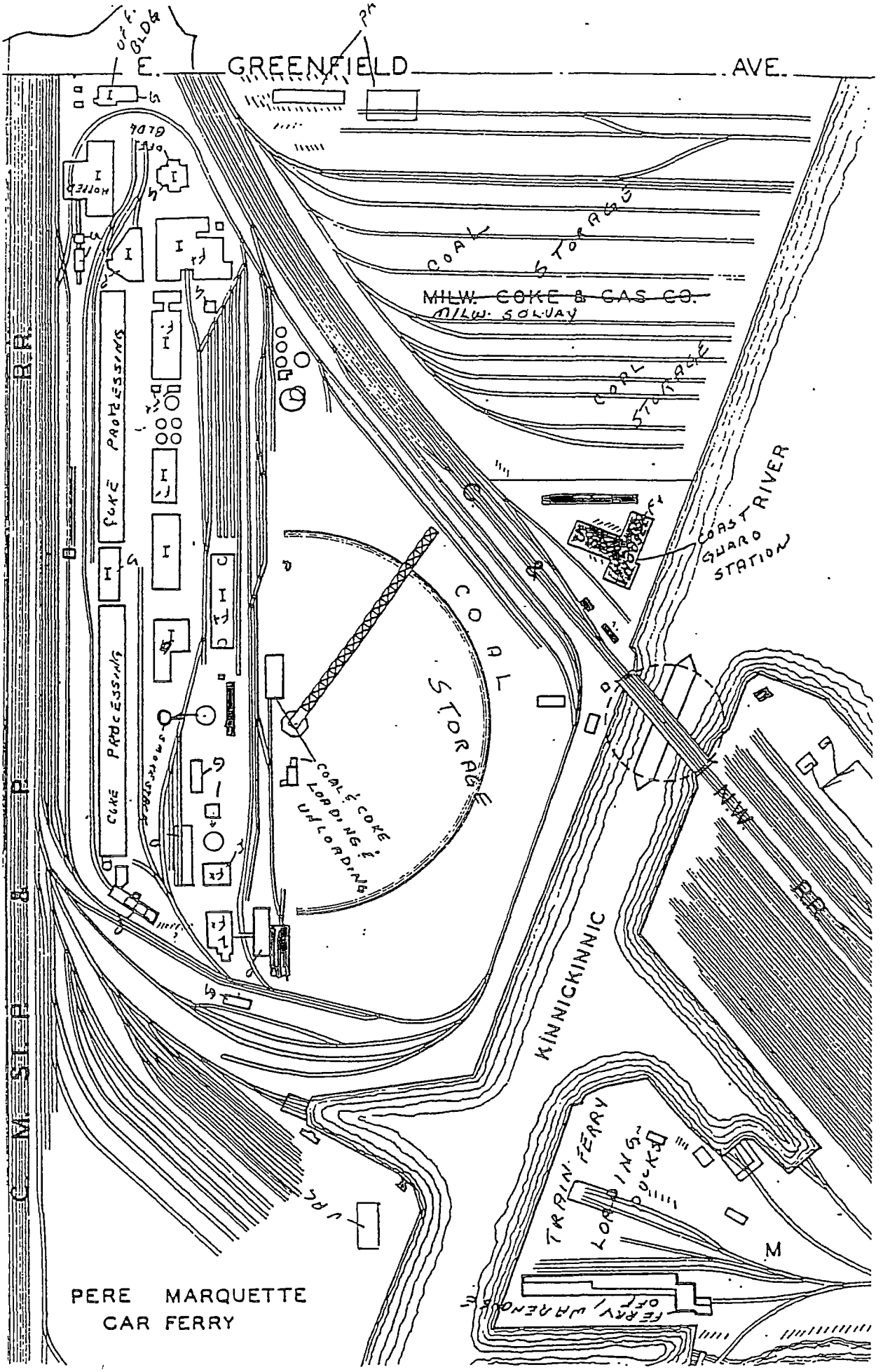
MAP 1. PROJECT BOUNDARIES: 311 W. GREENFIELD AVE.
(FORMER MILWAUKEE SOLVAY COKE & GAS CO.)

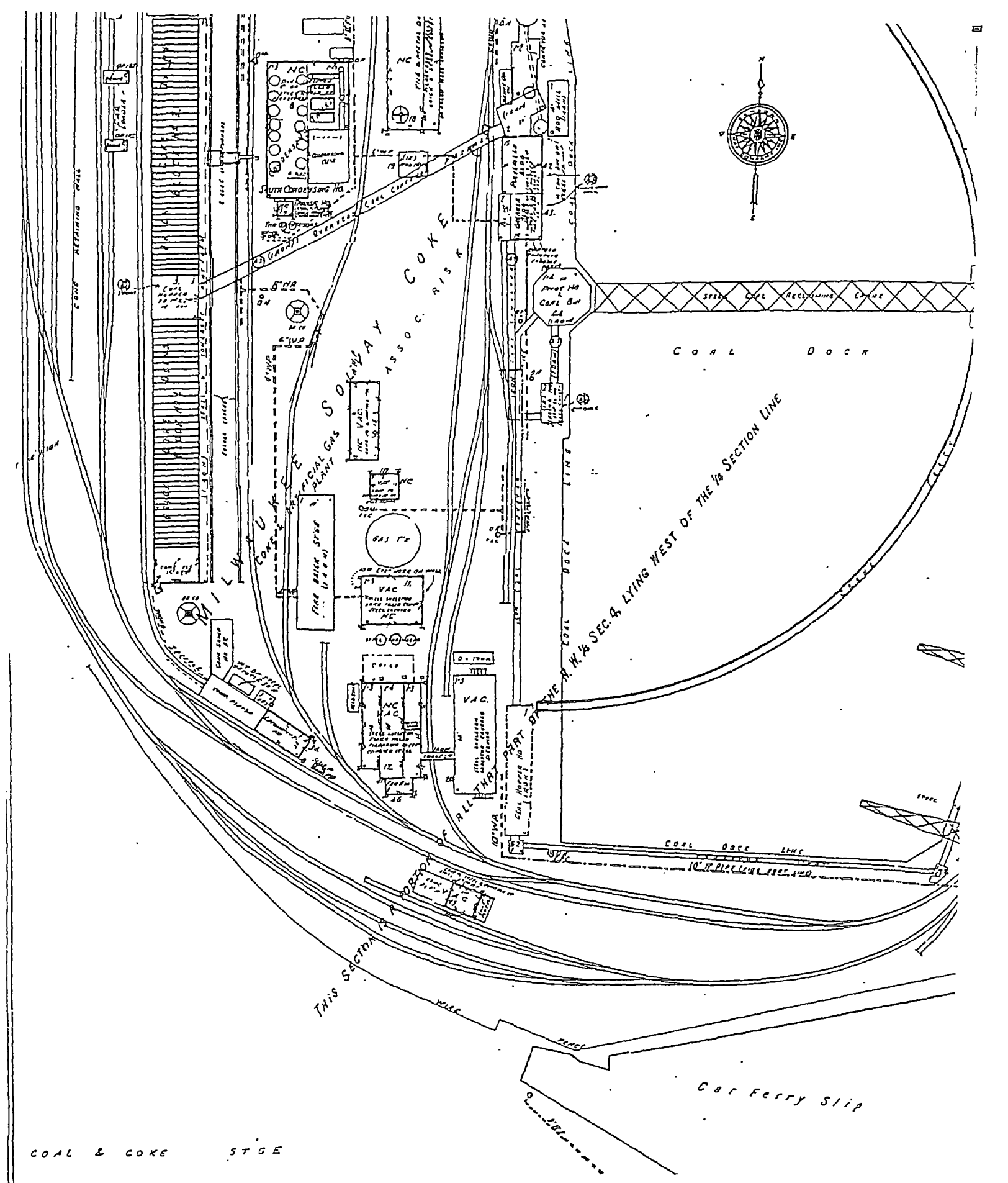


LAND USE MAP SHOWING FORMER MILWAUKEE SOLVAY COKE & GAS CO. PLANT



1912 LAND USE MAP SHOWING FORMER MILWAUKEE SOLVAY COKE & GAS CO. PLANT





MAP 4. 1969 SANBORN MAP SHOWING FORMER MILWAUKEE SOLVAY COKE & GAS CO. PLANT

1605 ~ 1014

ATTACHMENT A

MEMORANDUM OF LEASE/PURCHASE AGREEMENT

THIS MEMORANDUM OF LEASE/PURCHASE AGREEMENT, made and entered into as of the 27th day of June, 1983, by and between PICKANDS MATHER & CO., a Delaware corporation, hereinafter referred to as "Owner", and WISCONSIN WRECKING COMPANY, a Wisconsin general partnership, hereinafter referred to as "Wisconsin".

5686638 REGISTER'S OFFICE } ss
Milwaukee County, WI
RECORDED AT 11 40 AM
JAN 18 1984

WITNESSETH: REEL 1605 IMAGE 1018

REGISTER OF DEEDS

WHEREAS, by separate instrument of June 27, 1983, Owner and Wisconsin entered into a Lease/Purchase Agreement under the terms of which Owner has leased/sold to Wisconsin certain premises in the City of Milwaukee, Wisconsin, for the purpose of conducting certain business thereon; and

WHEREAS, the parties desire to give notice of the Lease/Purchase Agreement by this Memorandum.

DOC # 5686638 #
RECORD 12.70

NOW, THEREFORE, FURTHER WITNESSETH:

1. Owner hereby leases/sells to Wisconsin for the purpose of conducting certain businesses thereon that certain parcel of land situated in the City of Milwaukee, Wisconsin, known as The Milwaukee Solvay Coke Co. Division of Pickands Mather & Co. property, lying south of Greenfield Avenue, containing approximately forty-seven (47) acres, more or less, and being more particularly described on the attached Exhibit A, which is made a part hereof, sometimes herein referred to as "the premises", all upon the terms and conditions and subject to the limitations set forth in the Lease/Purchase Agreement.

)70

2. The Lease/Purchase Agreement shall be effective for a term beginning July 1, 1983 and ending March 1, 1998 or March 1, 1995, as Wisconsin shall determine.

3. Owner, in consideration of the covenants and agreements of Wisconsin contained in the Lease/Purchase Agreement, agrees that upon the prompt and full performance by Wisconsin, to convey the premises to Wisconsin by good and sufficient Warranty Deed, subject to all easements, conditions and restrictions of record, and unpaid installments of special assessments, if any, and to convey by Quit Claim Deed the riparian rights from the dock face on the premises to the center of the Kinnickinnic River.

IN TESTIMONY WHEREOF, Owner has caused these presents to be executed in its corporate name by its duly authorized officers and Wisconsin has caused these presents to be executed by one of its general partners as of the day and year first above written.

SIGNED AND SEALED in the presence of:

Kathleen M. Kenyk
KATHLEEN M. KENYK

Kathleen M. Schupp
KATHLEEN M. SCHUPP

Susan M. Rayschke
SUSAN M. RAYSCHKE

John F. Hogan
JOHN F. HOGAN

PICKANDS MATHER & CO.

By R. McInnes
R. McINNES, President

Attest R.J. Nordick
R.J. NORDICK, Assistant Secretary

WISCONSIN WRECKING COMPANY

By Marko M. Gerovac
(A General Partner
MARKO M. GEROVAC

STATE OF OHIO)
) SS.
COUNTY OF CUYAHOGA)

The foregoing instrument was acknowledged before me this [illegible] day of [illegible], 1983, by R. McInnes and R. J. Norwick, the President and Assistant Secretary, respectively, of PICKANDS MATHER & CO., a corporation under the laws of Delaware, on behalf of the corporation.

Notary Public

HELEN M. STEVENSON
Notary Public - State of Ohio - Lol. - Cty.
My Commission Expires Sept. 14, 1985

My commission expires [illegible].

STATE OF WISCONSIN)
) SS.
COUNTY OF MILWAUKEE)

The foregoing instrument was acknowledged before me this 14TH day of October, 1983, by MARKO M. GERNAC, a General Partner of WISCONSIN WRECKING COMPANY, a Wisconsin general partnership, on behalf of the partnership.

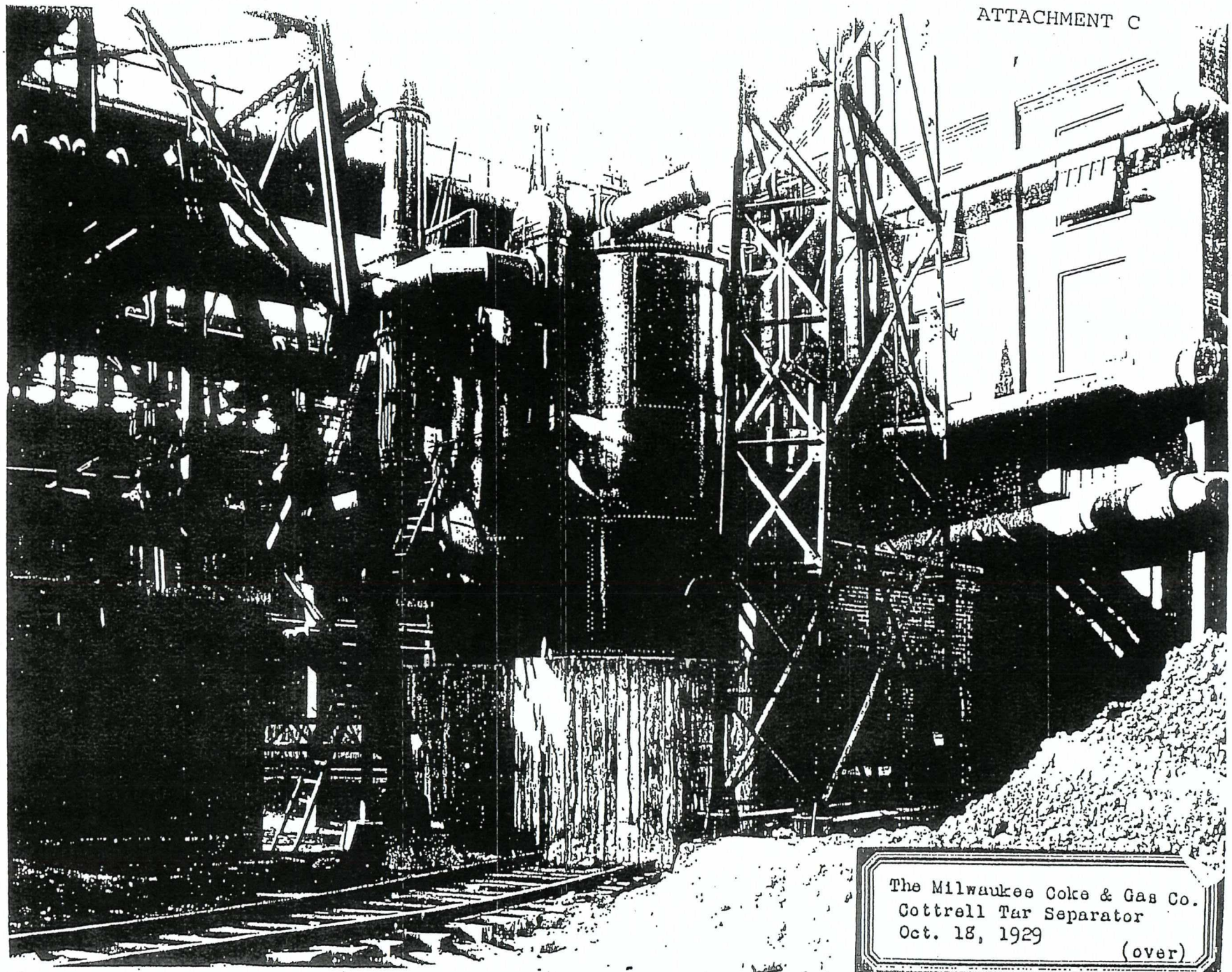
Notary Public
CHARLES F. MAGYERA

My commission ~~expires~~ IS PERMANENT.

The foregoing instrument was prepared by:

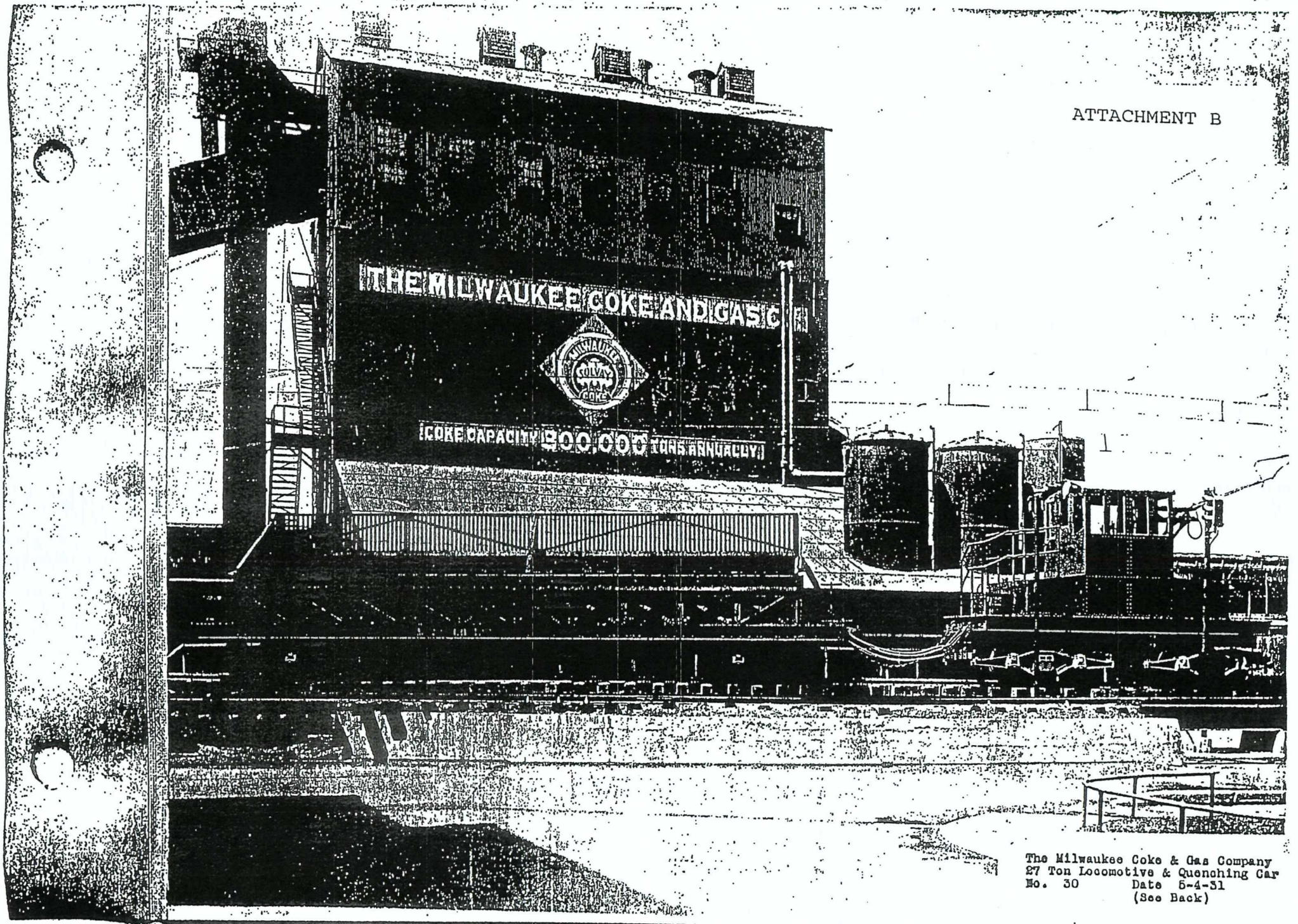
R. J. Norwick
Attorney-at-Law - Pickands Mather & Co.
1100 Superior Avenue
Cleveland, Ohio 44114

ATTACHMENT C



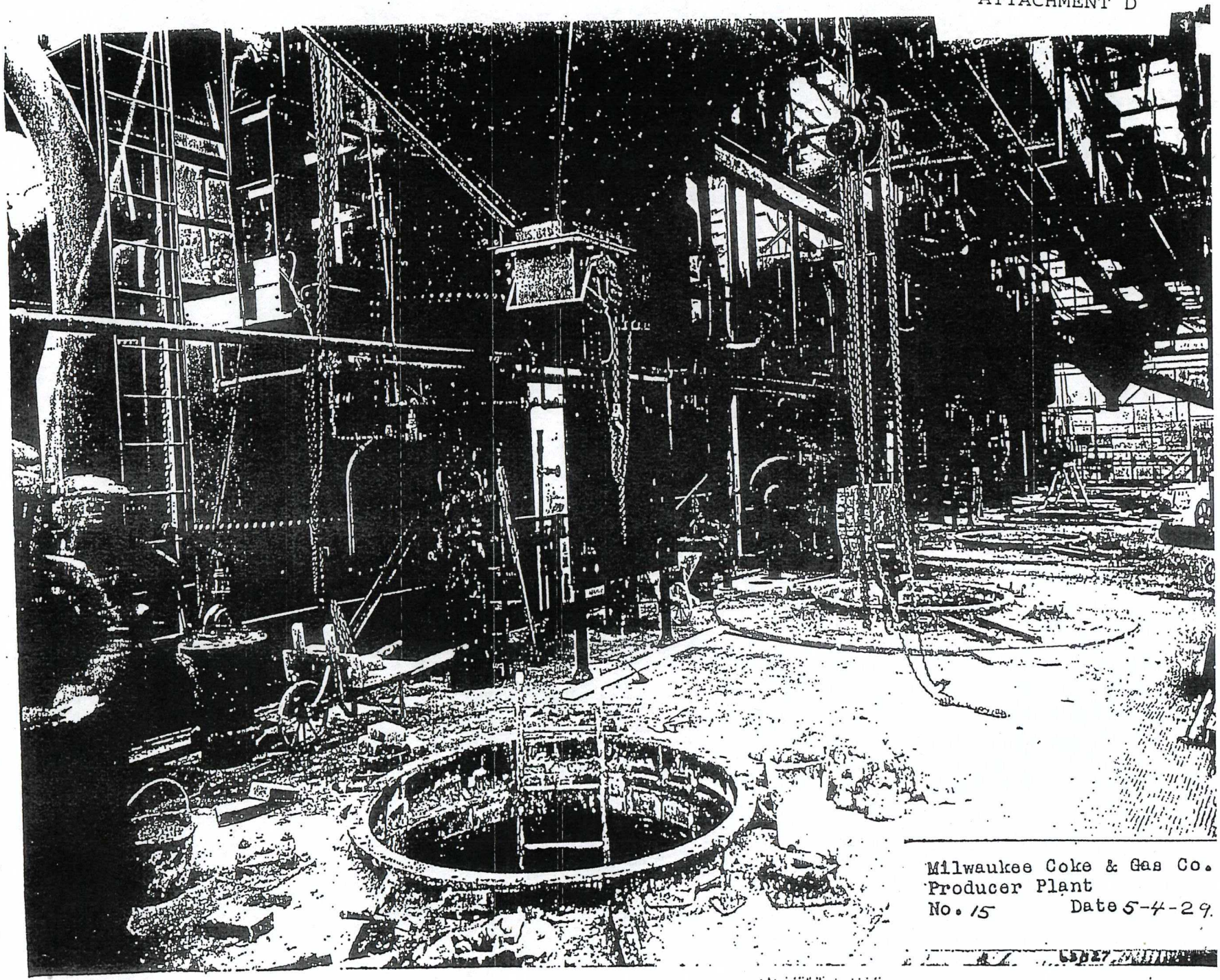
The Milwaukee Coke & Gas Co.
Cottrell Tar Separator
Oct. 18, 1929
(over)

ATTACHMENT B



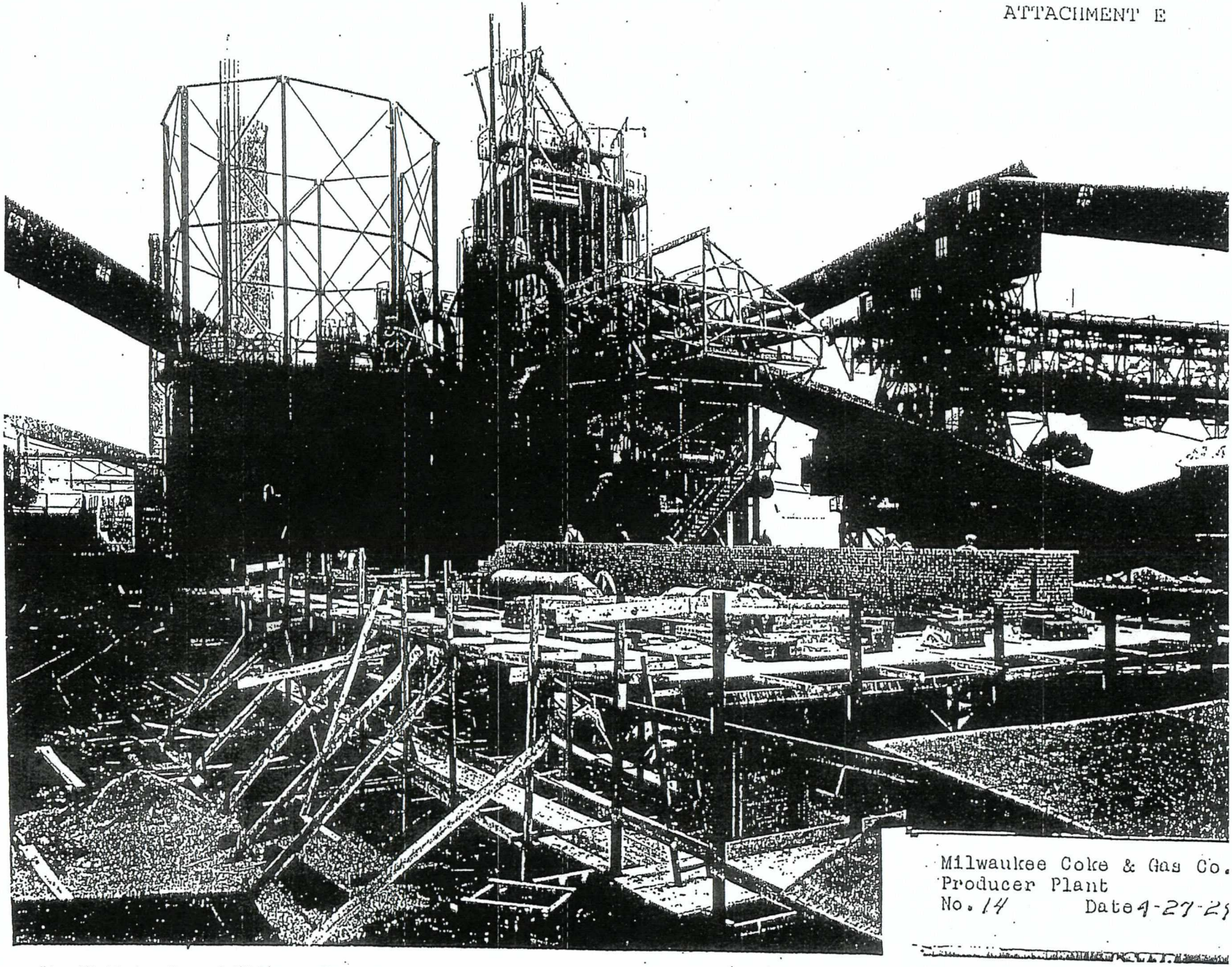
The Milwaukee Coke & Gas Company
27 Ton Locomotive & Quenching Car
No. 30 Date 5-4-31
(See Back)

ATTACHMENT D



Milwaukee Coke & Gas Co.
Producer Plant
No. 15 Date 5-4-29.

ATTACHMENT E



Milwaukee Coke & Gas Co.
Producer Plant
No. 14 Date 4-27-2[illegible]

ATTACHMENT F

Coal Tars Pose Cleanup Challenge

Residues from past coal gasification processes pose a cleanup challenge for today's facilities.

by Seyed M. Mohammadi, PhD, PE

Coal gasification for household and industrial use was widespread during the second half of the 19th century and reached its peak in the 1930s. In this process, coal was heated to release volatile gases that were used as an energy source in boilers and power generation units. The residues, known as coal tars, typically were buried on-site at the power plants.

Coal tars are composed mainly of polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOC) and phenols, and they may contain inorganic materials such as ammonia, lead and cyanides. Many of these chemicals are sources of environmental and/or health concern. Some of these constituents are suspected carcinogens.

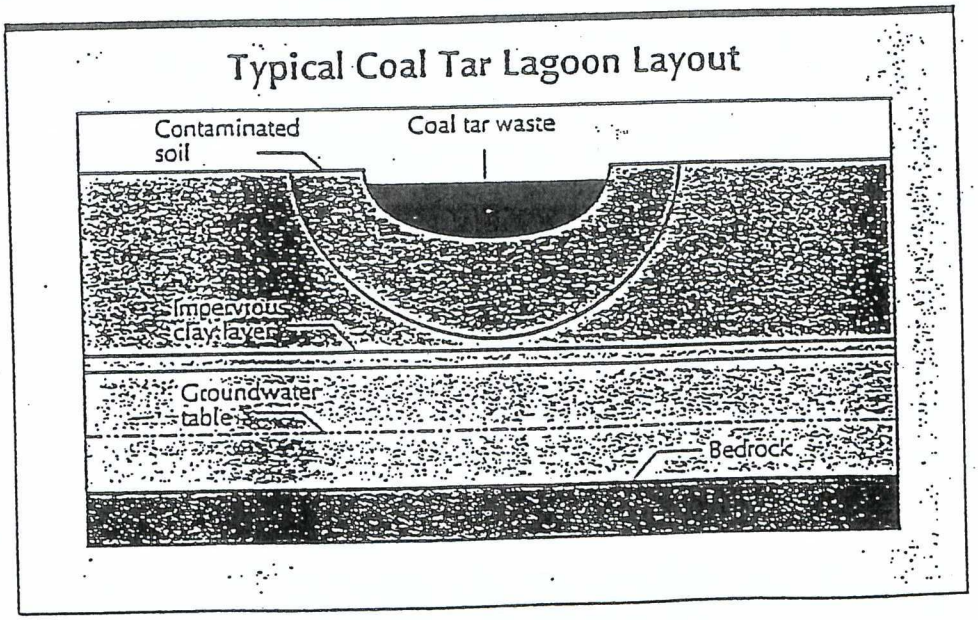
Coal consists largely of the elements carbon, hydrogen and oxygen with small amounts of sulfur present. Inorganic impurities are present as well and are designated as ash, the non-combustible residue after coal is completely burned. For purposes of energy analysis as fuels, the contents of coal and lignite are given in terms of percentages of fixed carbon, volatiles and water. Coals are ranked by fuel ratio, which is the ratio of fixed carbon to volatile matter. Volatiles burn in the form of gas and give a long, smoky flame, whereas fixed carbon produces a short, hot, steady, smoke-less flame.

The lower-ranking coals, lignite and subbituminous coal (intermediate between lignite and bituminous coal), not only have low heating value, but are subject to spontaneous combustion. Volatiles in bituminous coal are a source of gas also used as a fuel. To release these volatiles and obtain the most heating value from the coal, a number of processes are used.

Carbonization: Coal carbonization is used to make coal-gas, coke and byproducts. This is the oldest process where charges of bituminous coal are roasted in a controlled atmosphere at 2000°F to burn off part of the carbon, drive off volatile substances and yield three main product groups: metallurgical coke, coal tar and gases. The principal gas is carbon monoxide (with some methane and nitrogen), which is used as fuel gas and to make ammonia, methanol and other chemicals. Only about one-third of the tar finds its way into useful chemicals (roofing compounds, road tars, wood-preserving chemicals, paints and enamels), and nearly half of the coal tar chemicals remain commercially undeveloped.

Partial combustion: In this method, a jet of steam is blown over a bed of heated coal or coke (3000°F) in a closed chamber to produce large quantities of mixed carbon monoxide and hydrogen, the reactants of domestic fuel gas. This simple process was the first cheap method for adding reactive hydrogen (from water) to coal to get a synthesis gas that can be manipulated into many chemicals. This process is considered inefficient.

Fischer-Tropsch: If synthesis gas or residual gas



• Figure 1. Typical lagoons have 10 feet of tar with tar saturated soils below that.

from coal carbonization is fed across a cobalt or iron catalyst at low heat and pressure, a stream of products will form. They range from petroleum-like products to lubricating oils to a range of alcohols. By varying the controls (pressure and temperature), the preponderance of oils or chemical products can be altered. This process was created Franz Fischer and Hans Tropsch, two German scientists, in 1925.

Hydrogenation: This was the first chemical process to work directly on coal. A blast of pure hydrogen is shot into a paste of pulverized coal and catalyst at medium temperature (850°F) and high pressure (3000 pounds per square inch). This process literally explodes the coal molecules and attaches hydrogen to their dismembered chains and rings. This, with its massive addition of hydrogen, produces the widest range of coal chemicals: gasoline, diesel and heavy oils, benzene, phenols and a range of coal tar chemicals, aniline, a variety of nitrogen compounds, plus a small amount of hydrocarbon gas and high-grade coke. Depending on the catalyst and controls, oil products or other chemicals may be the major yield.

Components of coal tar

The composition of coal tar varies but is usually a mixture of the following:

- Polycyclic aromatic hydrocarbons (PAH), such as benzo-pyrene, naphthalene, anthracene acenaphthene and phenanthrene.
- Phenolic compounds, including phenol and methylphenols.
- Light aromatic compounds, such as benzene, toluene and xylenes.
- Miscellaneous organics, such as dibenzofuran.
- Small quantities of inorganic chemicals, such as iron, lead, copper, zinc, various sulfides, cyanides and nitrates.

The physical characteristics and chemical composition of the tar depend on the kind of coal from

Table 1
Analysis of PAH Portion of a Coal Tar Sample

Compound	ug/g[a]	Compound	ug/g[a]
C_1-benzenes	0.1	C_1-phenanthrene and/or C_1-anthracene	16.3
Naphthalene	6.1	Methylfluoranthene	13.0
Benzothiophene	0.3	Benzo{a}fluorene	32.6
Methylnaphthalenes	2.9	Benzo{b}fluorene	6.9
Biphenyl	0.9	Methylpyrene or Methylfluoranthene	23.2
C_2-naphthalenes	4.2	1-methylpyrene / Methyl fluoranthene	36.3
Acenaphthylene	1.0	C_2-pyrene and/or C_2-fluoranthene	44.4
Methylbiphenyls	0.4	Benzo{b}naphthothiophene	6.3
Acenaphthene	1.8	Benzo{c}phenanthrene	10.0
Dibenzofuran	0.7	Benz{a}anthracene	51.4
C_3-naphthalenes	3.9	Chrysene and/or triphenylene	46.0
Fluorene	13.0	Unknowns / Binaphthalene	14.6
C_2-biphenyls	1.7	Methyl-PAH 228	51.3
C_4-naphthalenes	0.8	Unknowns	11.7
C_3-biphenyls	3.5	C_2-PAH 228	22.2
Methylfluorenes	3.1	Methyl-PAH 254	9.8
Fluorenone	1.1	Benzo{b}fluoranthrene / Benzo{j}fluoranthene / Benzo{k}fluoranthene	72.4
Dibenzothiophene	2.2	Benzo{a}fluoranthene	11.6
Phenanthrene	19.4	Benzo{e}pyrene	28.8
Anthracene	12.4	Benzo{a}pyrene	39.0
C_2-fluorenes	3.1	Perylene	7.4
C_3-naphthalenes	5.1	Methyl-PAH 252	75.8
3-methylphenanthrene / 2-methylphenanthrene	23.1	Unknown	7.4
2-methylanthracene	4.1	Dibenz{a,j}anthracene	8.2
4-(or 9-)methylphenanthrene / 1-methylphenanthrene	37.8	Indeno{1,2,3-cd}pyrene	36.4
2-phenylnaphthalene	4.6	Dibenz{a,h}anthracene	14.8
C_2-naphthothiophenes	3.5	Pentaphene / Benzo{b}chrysene	13.8
3,6-dimethylphenanthrene / C_2-phenanthrene and/or C_2-anthracene	32.7	Benzo{ghi}perylene	31.4
Fluoranthene	58.2	Naphtho{1,2-k}fluoranthene / Dibenzofluoranthene / Dibenzo{a,e}pyrene	28.0
Acephenanthrylene	4.5		
(Phenylmethyl)naphthalene / Benzo{b}naphthol{2,3-d}furan	4.0	Total	1114.5
Phenanthrol{4,5-bcd}thiophene	2.5		
Pyrene	81.8		

[a]PAH concentration in dry soil (average of three extractions)
Source: Adapted from "Supercritical Fluid Extraction of Coal Tar Contaminated Soil," *Env. Sci. Tech.*, Vol. 24, No. 11.

The first step in treating coal tar sites is to define the extent of the problem.

which it was derived, the type of carbonization process, and the process temperatures.

Analysis of the PAH portion of a coal tar laden soil sample is presented in Table 1. Coal tars contain chemicals that do not readily biodegrade. For instance, fluoranthene and benzo-fluoranthene form major constituents of the analyzed coal tar sample. These two chemicals could be adsorbed by soil and bioaccumulated in the food chain. Another constituent, pyrene, is not biodegradable and has a tendency to accumulate in the food chain. Pyrene also is adsorbed by the soil particles, rendering the soil contaminated and difficult to treat with conventional methods.

Naphthalene is an important constituent because it does not adsorb to the soil particles and can be monitored as an indicator of soil and/or groundwater contamination from coal tars. Naphthalene acts as a finger print for the coal tar contamination plume.

PAH are generally immobile with low water solubility. Although PAH are insoluble, they usually are extracted by plant roots and enter the food chain. They will accumulate in fatty tissues once consumed by animals and/or humans. PAH typically are not biodegradable and exhibit a long life cycle. The most viable method of treating and/or destroying PAH appears to be incineration.

Coal tars contain chemicals that do not readily biodegrade.

Another constituent of coal tars is light aromatic compounds, such as benzene, toluene and xylenes. These chemicals are mobile, water soluble and volatilize easily. They also are suspected carcinogens.

Inorganic chemicals in coal tars range from heavy metals to cyanides.

Coal tar itself is not designated as hazardous waste, but the previously mentioned chemicals in coal tars are either regulated by the Resource Conservation and Recovery Act (RCRA), the Toxic Substance Control Act (TSCA) and/or the Clean Water Act (CWA).

Coal tar deposits can exist in four fractions: a solid or semi-solid fraction; two liquid fractions (one heavier than water, one lighter); and a water-soluble fraction. The solid or semi-solid tars tend to remain where deposited. The heavier-than-water liquid fraction can sink until it reaches an impermeable clay or bedrock layer, at which time it can move horizontally depending on site factors. The lighter-than-water portion floats and therefore can move on the groundwater surface. The water soluble component dissolves into the groundwater.

Industrial generators of coal tars

Generators of coal tars are those industries that used coal as a source of energy. Steel mills and utility plants (power generation units) were the major coal users and coal tar generators. This discussion will concentrate on utility companies.

Utility companies like other industries, used the coal in one of the methods described. A portion of coal tars were sold as tars but the majority were and filled on-site and/or placed in lagoons on the utility's property. Once these lagoons reached capacity, they were covered with soil. In some instances parking lots, and/or structures were built on the lagoons. Although some of the lagoons were lined with concrete, the majority were unlined earthen depressions created during the construction phase of the plant. Also, to prevent capillary rise of tars to the surface, some lagoons were covered with a massive amount of concrete.

Typical lagoons have 10 feet of tar with tar saturated soils below that. Depending on the type of soils available in the area, the thickness of this tar-saturated layer varies. A typical lagoon is shown in Figure 1. In this case, groundwater is separated from the lagoon by an impervious soil stratum, therefore groundwater or at least a major aquifer will not be contaminated. In a situation where groundwater does comes in contact with contaminated soils on a routine basis groundwater contamination will result.

Cleanup of coal tar contaminated sites

The first step in cleaning and/or treating coal tar contaminated sites is to define the extent of the problem. This will involve reviewing available records, as well as interviewing former employees responsible for operating the facility to get a better estimate of disposal site(s). Once the lagoons and/or landfills are tentatively located, the extent of contamination must be defined. This typically involves many different tools such as soil-gas studies, field electrical resistivity tests, and borings by either hand augers and/or drill rigs. Soil borings can be converted to groundwater monitoring wells.

PAH typically are not volatilized and are one of the more difficult chemicals to treat. Steam-stripping of contaminated soils has offered reasonable success in treating the contaminants. Chemical flushing of soils also has offered reasonable success.

A new method involving extraction of coal tars from soil using supercritical fluid shows promise on a laboratory scale. Liquid carbon dioxide under high pressure (3000 psi) at 130°F is passed through the contaminated soils. The liquid flushes the contaminants out of the soil particles. Next, the liquid carbon dioxide is decompressed causing the CO_2 to turn into a gas, thereby precipitating the extracted PAH. Carbon dioxide gas is then pressurized to liquid form and the process is repeated.

Figure 2 shows a decision-making flow chart for a typical coal tar lagoon cleanup. The utility company should establish cleanup objectives (future use of the site), and negotiate these objectives with the regulatory agency. The engineering firm should be involved

in the negotiation process from the beginning. This might be the most important cost-saving step in the entire process. It is also important to remember that a successfully completed coal tar clean-up project does not necessarily mean removal of every grain of the contaminated soil; it does mean using common sense and engineering judgment to develop the most economical and environmentally sound solution.

Because some of the coal tar constituents are covered by the Land Ban regulations, a common procedure for site cleanup is excavation of the contaminated soils and buried coal tar residues, and commingling them with coal for subsequent burning in power stations. Groundwater treatment may be an essential part of the site cleanup, ranging from pump-and-treat to in-situ bioremediation to construction of slurry trench cut-off systems.

Another important consideration on these projects is health and safety of workers. This involves setting up clearly defined work areas. These areas range from the most contaminated area (Hot Zone) to decontamination stations for equipment and personnel to command centers and first aid stations.

Case study

A midwest utility was faced with a coal tar lagoon cleanup when a large disposal area was discovered on their property. The lagoon was underlaid by a naturally occurring impervious clay layer, which acted as an aquitard, separating the lagoon from a major aquifer. The Mississippi River runs approximately 3000 feet to the east of the utility site, providing a water recharge source for the aquifer.

After determining the hydraulic connection between the river and the aquifer, the main issue was excavation and removal of the lagoon contents without jeopardizing the integrity of the aquitard. It was feared the hydrostatic uplift pressure of the aquifer would "punch through" the clay layer. The decision was to excavate the lagoon contents under water.

Laser-guided backhoes with long excavation arms were used to excavate the coal tar residues and contaminated soils. The laser provided the required control mechanism for the excavation. The excavated materials were placed in a dewatering lagoon where contaminated water was gravity-drained back into the original lagoon. Dewatered excavated materials were transferred by truck to railcars for shipment to the utility company's power generating plant. At the plant, the excavated materials were mixed with coal and used as fuel. No groundwater contamination was encountered at the site.

During construction of a new highway adjacent to the site, the highway construction crews observed coal tar residues leaching into their excavation sites. More lagoons and coal tar disposal sites were found at the utility company's site. An interceptor channel was built to prevent migration of coal tar residues off-site. This phase of cleanup is currently in progress.

Sayed M. Mohammadi, PhD, PE, is engineering manager for PDC Technical Services Inc., Peoria, Ill.

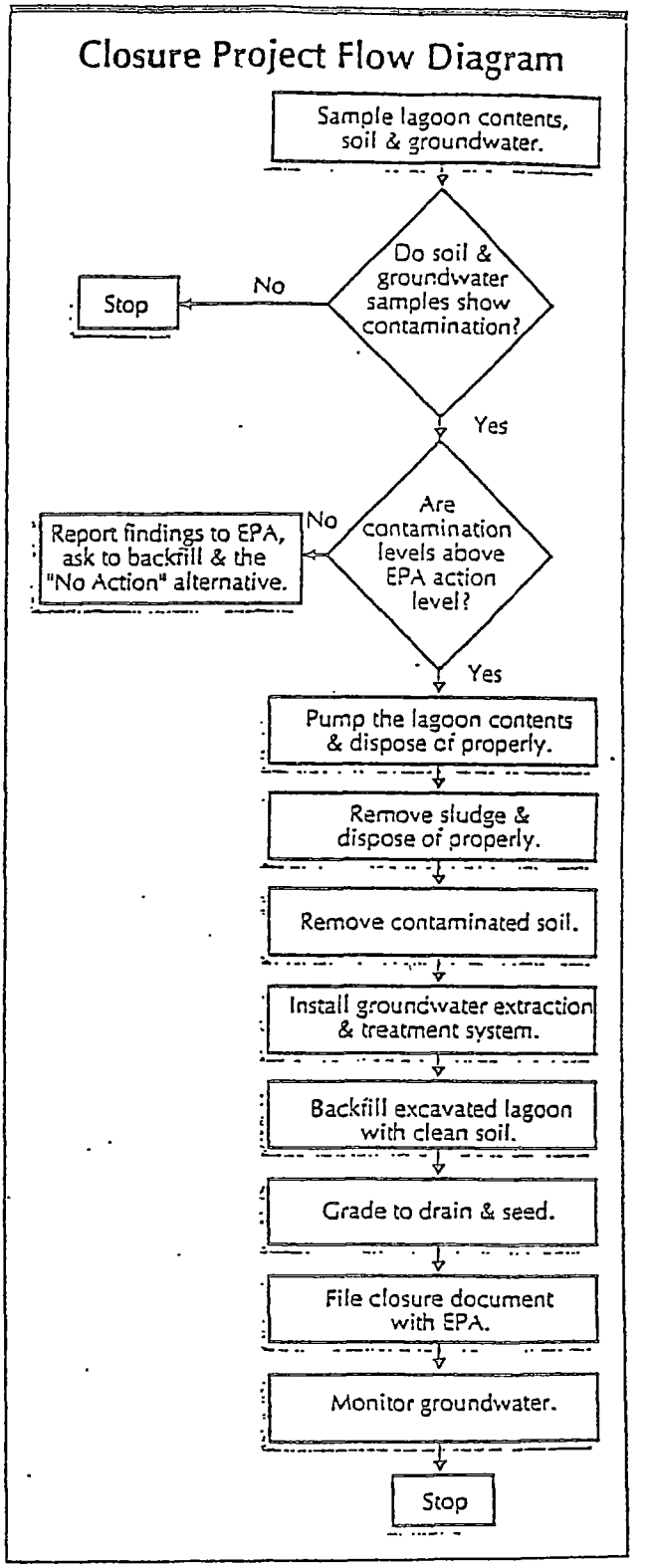
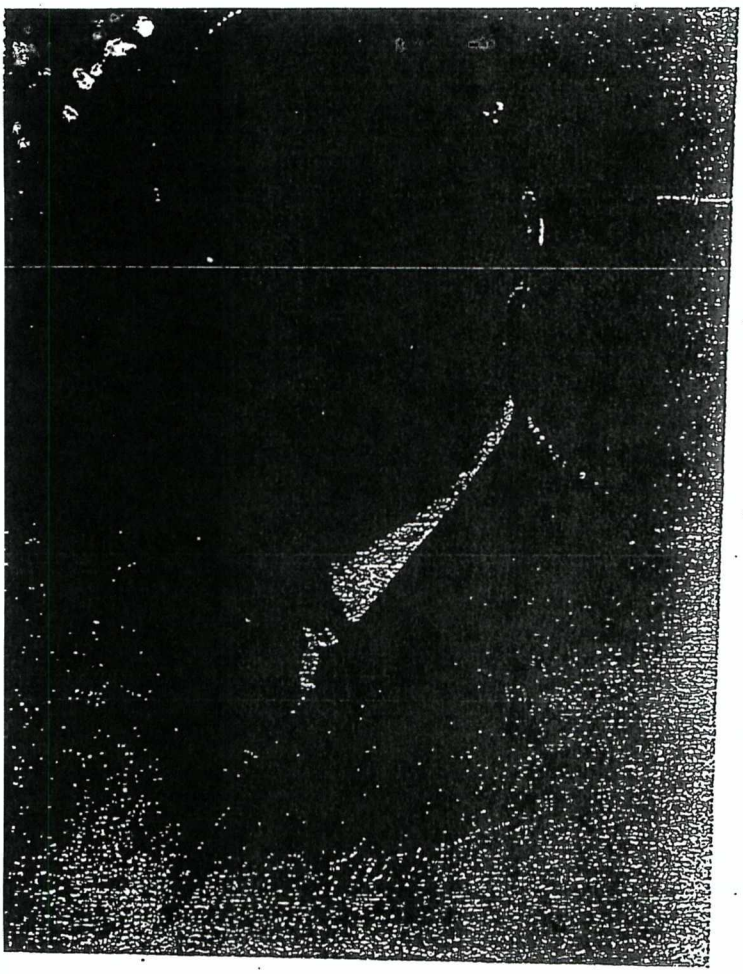


Figure 2. The decision-making process for a typical coal tar lagoon cleanup begins with identifying the problem.



Men of Achievement in Wisconsin, 1946, John Moranz Associates, Milwaukee

273-8288

James Albert Lovett

PRESIDENT

MILWAUKEE SOLVAY COKE CO.

James Albert Baker Lovett, president of the Milwaukee Solvay Coke Company, was born in Guirley, Alabama on September 23, 1894.

After finishing the elementary schools, he studied at the Alabama State Normal College, and the Carnegie Institute of Technology.

His first position was that of assistant chief chemist at the United States Cast Iron Pipe and Foundry Company, and then assistant superintendent of the Thomas A. Edison benzol plant at Woodward, Alabama, and later became assistant superintendent of by-products at the McKinley Steel Company, following in the same capacity with the Jones & Laughlin Company.

Mr. Lovett had a period of foreign work as representative for the Koppers Company, superintendent of operations of Koppers Construction Company, then general superintendent of Koppers Gas and Coke Company. Returning, he became vice-president of the Hamilton Coke and Iron Company of Hamilton, Ohio, from 1932 to 1936. From 1936 to 1939 he was affiliated with the Hamilton Coke and Iron Division of The American Rolling Mills Company as manager, and since 1939 has been president of Milwaukee Solvay Coke Company.

Mr. Lovett's hobbies are aeronautics and yachting, and one of his principal diversions is reading biochemical literature.

During the war period, he was appointed general chairman by General H. H. Arnold of the Civilian Aide Committee of the Army Air Force for the State of Wisconsin and upper Michigan; was a member of the National Advisory Coke Committee of the Solid Fuel Administration for War; also an alternate member of OPA Advisory Committee for coke and chemicals.

Mr. Lovett is a director of the Boy Scouts; Director Junior Achievement; a Kentucky Admiral, and a director of the Milwaukee County Community Fund. He is a member of the University Club, Milwaukee Club, and Milwaukee Yacht Club, and also has memberships in the American Iron and Steel Institute, American By-Product and Coke Institute and American Gas Association.

The Milwaukee Solvay Coke Company, with its plant at 311 E. Greenfield Avenue, and its sales office at 740 North Milwaukee Street, Milwaukee, Wisconsin, was incorporated in the State of Wisconsin on December 9, 1902, as The Milwaukee Coke and Gas Company.

At that time, the control of the company was vested in the so-called Schlesinger interests.

Products manufactured by this company include: metallurgical coke, coal gas, coal tar, ammoniacal liquor, benzol, toluol, xylol, and pyridine.

In time of war, these products are essentially important, as steel manufacturers require large quantities of coke. Ammonia and toluol are used in the manufacture of explosives. Peace-time products are the same as those produced in war. Coke is used by the metallurgical trade and for domestic purposes. Gas is sold to the Milwaukee Gas Light Company which supplies gas for public use in the vicinity of Milwaukee. Other by-products are sold for industrial use.

Some of the firms furnished with the products of this company are Carnegie-Illinois Steel Corporation, Inland Steel Company, Youngstown Sheet and Tube Company, Allis-Chalmers Mfg. Company, International Harvester Company, J. I. Case Company, Calumet & Heckla Consolidated Mining Company, Goodyear Tire & Rubber Company, Hercules Powder Company, Shell Oil Company and numerous foundries.

The company is a member of the American Retail Coal Association, Milwaukee Association of Commerce, National Association of Manufacturers, National Fuel Credit Association, Wisconsin Manufacturers Association, and American By-Product Coke Institute.